The temperature averaged −40° F. until 1 a.m., January 30, when it took an upward trend. The pressure remained low all day January 29, the barograms showing high amplitude oscillations of the order of 0.15 inch. At 8 p.m. the pressure started to rise.

The summit was in fog all day, but rime was not forming to any appreciable extent. A very thin, whitish film would deposit on a thermometer after 4 or 5 minutes' exposure, but it was not enough to obscure the spirit column or the graduation. It was hard to determine whether the deposit originated from minute undercooled water droplets or snow or ice particles.

On January 30, the temperature rose gradually during the morning. It was practically steady in the afternoon, and at 8 p.m. started to rise again. The pressure rose rapidly during the day. The NW. wind gradually decreased in velocity to 25 mi/hr late in the evening. It was clear, with visibility 9 all day, the only cloud being a small Altocumulus lenticularis to the northeast of the summit in the early morning. Fractocumulus clouds of peculiar cumulus appearance were forming at 1,800 meters on the west side of the mountain, the top occasionally reaching the summit level.

January 31 marked the end of this severe cold wave as the temperature reached −4° F. at noon and continued to rise in the afternoon. The temperature of −46.5° F. recorded at 10 a.m. January 29, and the pressure of 22.187 inches by mercurial barometer, and 22.15 inches by barographs, recorded the same morning at 7:40 a.m. and 7:15 a.m. respectively, are the lowest since the establishment of the present observatory (October 1932).

Temperatures were measured with standard alcohol thermometers, and continuously recorded by means of thermographs of the Bourdon tube type. Mercurial thermometers became sluggish at about −30° F. and were useless at lower temperatures. The wind movement was continuously recorded by means of an electrically heated anemometer of special design. Pressure measurement was obtained with a standard mercurial barometer and also with both a mercurial and an aneroid barograph.

Some of the observers, equipped with windproof clothing, were exposed to the extreme combination of 100–120 miles an hour wind and 43° below zero for nearly 1 hour without experiencing any physical discomfort. During the whole period that the cold wave lasted, minor nose frost bites resulted, no more painful than ordinary sunburns.

STORMS OVER THE NORTHEAST PACIFIC OCEAN AND ADJACENT LAND AREAS IN DECEMBER 1933

By R. C. COUNTS, JR.

[Weather Bureau office, San Francisco, Calif., February 1934]

The weather in the far Western States during December 1933, was characterized by an excess of precipitation and abnormally high mean temperatures, except in California where the mean temperature approximated the normal. Precipitation averaged nearly 21 inches in the western portion of Washington and Oregon, establishing a new record for the month, while in the eastern portion of each of these States and also in Idaho, the average has been exceeded in few previous years. Serious flood conditions with the attendant devastation and isolation of communities over a large part of Washington and northwestern Oregon resulted from these exceptionally heavy rains. The number of cloudy and rainy days also established some new records. The mean temperature was the highest of record for December in Oregon and it was one of the mildest Decembers of record in Washington, Idaho, and Nevada. These mild temperatures and heavy rains melted the mountain snows, the run-off of which, along with the high tides caused by strong winds over land and offshore, aggravated the flood condition. On the last day of the month rains deluged an area in southern California between the coast and the San Gabriel and upper ranges of the San Bernardino Mountains, flooding the Los Angeles area and breaking records in that section for the heaviest rainfall in 24 hours. The largest amount was 13.42 inches at Glendale. The cause of these phenomenal rains necessarily requires at least a brief outline of the storm movements and anomalous distributions of the various air masses over the northeast Pacific and the adjacent portion of this continent.

Throughout the greater part of the month a mass of cold air overlay Bering Sea and Alaska, and extended southeastward over Canada and the eastern portion of this country. However, the part over the Eastern States broke off at times from the larger air mass and moved on, giving place to warmer air during the eastward passage of a depression. On the first 18 days this mass was charted from the Bering Sea southward or southeastward over the ocean, quite often reaching the California coast, and after the first few days covered the Gulf of Alaska during the remainder of the month. The extent and intensity of this polar air mass were such that pressures at all stations on the coast of Alaska and British Columbia were far above normal while temperatures were correspondingly as far below normal. Pressures over California and the Southwest were relatively high although about normal, but Washington and Oregon, situated on or near the most frequented storm path, showed subnormal pressures and a decided excess in temperature. Winds at Juneau, Alaska, between the 8,000 and 14,000 foot levels, except during a few days in the first week, were nearly northwest and usually of gale force. Winds of this character over Juneau, and cold air spreading from Alaska out over the ocean to approximately latitude 50°, precluded the possibility of cyclonic development over the Gulf of Alaska. The result was that the mean path of storms over the northeast Pacific was displaced far to the south of the normal storm path. With a few exceptions during the opening days of the month the path lay south of latitude 50°, but on every occasion the storm track onto the continent was along or near the Washington-British Columbia border.

Normally, the marked contrast between the polar air and the warmer air over the ocean is near the Alaskan and Canadian coastline and it is along this line of discontinuity that cyclones are so frequently generated and near which those moving from a region in higher latitudes farther west establish a path. In December 1933, with the drainage of cold air southward the surface of discontinuity was, of course, established 10° to 20° in latitude farther south over the ocean, and occasionally when the cold air reached from Bering Sea to latitude 30° this surface of contrasting temperatures was appearing in rather low latitudes. The dynamic equilibrium of these masses of air flowing side by side in opposite directions could not be maintained and cyclones having their in-

ception along the interface between these masses, were unusually frequent. Others moved intact across the ocean from the region west of the 180th meridian, but followed a more southerly path than normal. The processes involved in the formation of these cyclones were not changed but the place of origin was and this was an important factor in the cause of heavy rains in the Pacific Northwest. By virtue of their development in lower latitudes these depressions had easier access to a larger supply of warmer, moister air and their forward portions were heavily laden with water vapor. The Pacific Northwest was usually within the path of the heavily moisture-laden sectors of cyclones and too, the rainfall was increased by the effect of forced ascent of the strong, moist, southerly winds by the mountains. At the close of the month one of these disturbances moved southeastward with the result that large amounts of warm, moist air were transported to southern California and the area around and immediately to the north and west of Los Angeles received record-breaking rains. Again, the forced ascent of the moist winds by the sharp increase in elevation of that area back from the coast intensified what otherwise might have been unusual rains but not quite so heavy as occurred.

AN UNUSUAL SOLAR HALO AT PORTLAND, OREG., FEBRUARY 15, 1934

By W. H. WOODWARD

[Weather Bureau office, Portland, Oreg., February 1934]

An unusually brilliant display of solar halos was observed at Portland, Oreg., between 7:50 a.m. and 8:55 a.m. February 15, 1934, on which date the sunrise was at 7:14 a.m. These refraction phenomena were of unusual interest for two reasons. First, the circumzenithal arc remained of nearly constant form and brilliancy from the time it was first witnessed at 8:20 a.m. until it vanished at 8:50 a.m. This period of 30 minutes during which this phenomon was visible is quite unusual. W. J. Humphreys in "Physics of the Air", and Louis Besson in "The Different Forms of Halos and Their Observation", mention that this phenomenon does not long remain visible, 5 minutes on the average. This circumzenithal arc, approximately 60° long, was very brilliantly colored and like an exceptionally bright rainbow. Second, during the time of the year when there are cirrus clouds at Portland, the witnessing of solar halos usually is impossible on account of the prevailing lower clouds.

The other refraction phenomena witnessed during this time were: A quarter arc of the great halo of 46°; two short arcs of the halo of 22°, which at times were bright and of such width as to be in juxtaposition with the ordinary parhelia of 22°; and, the upper tangent arc of the halo of 22°. At 7:50 a.m. a bright halo of 22° formed in juxtaposition with the ordinary parhelia of 22°, and simultaneously a brilliant upper tangent arc developed. These halos were clear in color—red toward the sun to violet, inclusive—and remained visible with changeable hue until about 8:45 a.m. At 8:20 a.m. the lower portion of the great halo of 46° and the circumzenithal arc were observed to appear at approximately the same time. Fifteen minutes later, the arc of the great halo of 46° extended from the level of the sun to the circumzenithal arc, to which it was tangent. This great halo arc remained of constant form, brilliantly colored, resembling a secondary rainbow in depth of color, and did not fade until 8:50 a.m.

TORNADOES IN LAUDERDALE COUNTY, MISS., SUNDAY, FEBRUARY 25, 1934

By E. E. UNGER

[Weather Bureau office, Meridian, Miss., Mar. 8, 1934]

The weather map of Sunday morning, February 25, 1934, showed a crescent LOW extending from Utah southeastward through Texas and thence northeastward to the lower Ohio Valley with separate centers over western Colorado, extreme southern Texas, and southwestern Arkansas, while a large area of high barometric pressure, crested over Alberta and Saskatchewan, was pushing its way southward over the Plains States attended by a cold wave and fresh to strong winds as far south as the Texas Panhandle and Oklahoma. The temperatures that morning were as low as 14° at Amarillo, Tex., while temperatures of 60° or more prevailed over southern and eastern Texas, Louisiana, and central and southern Mississippi. Every indication pointed to a rapid northeastward movement of the LOW and an equally rapid southward movement of the HIGH with its attendant cold wave. Thus the stage was set for a stormy Sunday over eastern Mississippi with rain, hail, thunderstorms, squall winds, and a generally turbulent condition.

The weather conditions prevailing through Sunday, February 25, in Lauderdale County, Miss., of which Meridian is the county seat, were cloudy and somewhat unsettled with mild temperatures at 7 a.m., followed by a slight breaking away of the clouds and a little sunshine in mid-forenoon, after which time the clouds became thicker. From about noon to nightfall the cloud blanket was so heavy, with clouds moving rapidly from the southwest, that the use of lights indoors was necessary if one wished to read or write. The first rain began at Meridian at 10:55 a.m. and the first thunder was heard at 11:55 a.m. Intermittent showers prevailed at Meridian to 3 p.m., heavy rain from 3 p.m. to 4:45 p.m., followed by moderate and then light rain to 8:15 p.m. Light hail, stones about the size of large sized peas, accompanied the heavy rain from 3:09 p.m. to 3:17 p.m. The wind, more or less variable with increasing gustiness, was generally from the southwest from 7 a.m. to 3:20 p.m. after which it shifted through west to north at 3:50 p.m., then to northeast between 5 and 6 p.m., then more or less variable but generally southeast till after 10 p.m., when the prevailing direction became northwest or west and the temperatures of the incoming cold wave first became noticeable. During the period of heavy rainfall, the winds were more of less squally, with a maximum velocity (true) of 28 miles per hour from the SW at 3:12 p.m. and an extreme of 37 miles per hour at 3:14 p.m. Although the data given in this paragraph are taken from the records of the Weather Bureau office at Meridian, yet from information obtained from interviews with a number of persons, the weather conditions prevailing throughout this and surrounding counties on Sunday, February 25, were very similar as to cloudiness, rain,